Microstructure, strengthening mechanisms and strength-structure relationships in cold-drawn pearlitic steel wire

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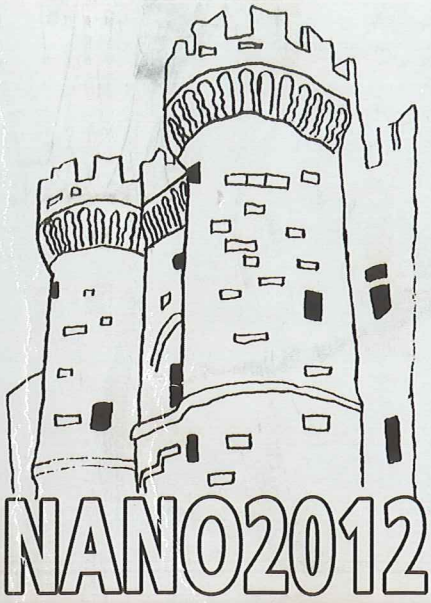
Published in:
Final program

Publication date:
2012

Document Version
Publisher's PDF, also known as Version of record



NANO2012

26-31 August 2012

www.nano2012.org

Rodos Palace Convention Center

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XI International Conference on Nanostructured Materials

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11:30 **(Invited) Microstructure, strengthening mechanisms and strength-structure relationships in cold-drawn pearlitic steel wire**
X. Zhang[1,2], X. Huang[1], N. Hansen[1], A. Godfrey[2]
[1]Danish-Chinese Center for Nanometals, Materials Science and Advanced Characterization, Department for Wind Energy, Risø Campus, Technical University of Denmark, Roskilde, Denmark, [2]Advanced Materials Laboratory, Department of Materials Science and Engineering, Tsinghua University, PR, China

12:00 **Nanocrystalline powders for nuclear energy application**
V. F. Petrunin, V. V. Popov, S. I. Grechishnikov, S. A. Korovin
National Research Nuclear University MEPHI, Moscow, Russia

12:15 **Nanoporous hybrid organosilica membranes for energy-efficient molecular separation**
H. L. Castricum[1,2], G. G. Paradis[3], M. C. Mittelmeijer-Hazeleger[1], R. Kreiter[3], J. F. Vente[3], G. Rothenberg[1], J. E. ten Elshof[2]
[1]Van 't Hoff Institute for Molecular Sciences, University of Amsterdam, Amsterdam, The Netherlands, [2]MESA+ Institute for Nanotechnology, University of Twente, Enschede, The Netherlands, [3]Energy Research Centre of the Netherlands, Petten, The Netherlands

12:30 **TiO_2 nano-structured thin films sensitized with a novel unsymmetrical Zn-Phtalocyanine bearing a push-pull system for application in Dye Sensitized Solar Cells**
G. Pellegrino[1], A. Alberti[1], G. G. Condorelli[2], A. M. Paoletti[3], G. Pennesi[3], G. Rossi[3], G. Zanotti[3]
[1]CNR-IMM, Zona Industriale, Catania, Italy, [2]Università degli Studi di Catania and INSTM UdR of Catania, Catania, Italy, [3]CNR-ISM, Monterotondo-Stazione, Roma, Italy

12:45 **Synthesis and characterization of gallium nitride nanotubes**
C. Hemmingsson, G. Pozina
Department of Physics, Chemistry and Biology (IFM), Linköping University, Linköping, Sweden

13:00 **Nanostructure effects induced by ball milling of complex hydrides for solid state hydrogen storage**
R. A. Varin, R. Parviz
Department of Mechanical and Mechatronics Engineering, University of Waterloo, Waterloo, Ontario, Canada

13:15 – 16:30 **B r e a k**

16:30 – 18:00 **SELF-ASSEMBLY ON SURFACES AND FUNCTIONALIZATION IN ATOMIC CLUSTERS IV**
Chair: J. H. Dickerson

16:30 **(Invited) Fluctuations in low-dimensional systems: A novel state of matter?**
E. Bertel
Institute of Physical Chemistry, University of Innsbruck, Austria

17:00 **Fabrication of nanocell lattice on semiconductor utilizing point defects movement induced by ion irradiation**
M. Taniwaki, N. Nitta
Kochi University of Technology, Kami-city, Japan

17:15 **Interface and grain boundary nanoparticles in Cu-Fe and Cu-Co solid solutions**
S. Zhevnenko[1], M. V. Gorshenkov[1], A. Khvan[1], R. Adam[2], V. Klemm[2]
[1]National University of Science and Technology "MISIS" Moscow, Russia, [2]Freiberg University of Mining and Technology, Institute of Materials Science, Freiberg, Germany

MICROSTRUCTURE, STRENGTHENING MECHANISMS AND STRENGTH-STRUCTURE RELATIONSHIPS IN COLD-DRAWN PEARLITIC STEEL WIRE

Xiaodan Zhang[a,b], Xiaoxu Huang[a], Niels Hansen[a], Andrew Godfrey[b]

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Microstructure, strengthening mechanisms and strength–structure relationships have been analyzed in a cold-drawn pearlitic steel with a structural scale in the nanometer range and a flow stress up to about 3.5 GPa. Structural parameters including the interlamellar spacing, dislocation density in the ferrite lamellae and the cementite decomposition, have been analyzed and quantified by transmission electron microscopy and high resolution electron microscopy for wires cold drawn up to a strain of 3.7. It is found that the interlamellar spacing and the thickness of the cementite lamellae are reduced in accordance with the changes in wire diameter up to a strain of 2.5. At a higher strain enhanced thinning of the cementite lamellae points to decomposition of the cementite and carbon enrichment of the ferrite lamellae. Dislocations are stored in the interior of the ferrite lamellae and their density increases to about $2\times10^{16}m^{-2}$. Three strengthening mechanisms, boundary strengthening, dislocation strengthening and solid solution hardening have been analyzed. The individual and combined contributions, of these mechanisms to the wire strength have been estimated. Good agreement has been found between the measured flow stress and values estimated based on an assumption of linear additivity of the three strengthening mechanisms.

The authors gratefully acknowledge the support from the Danish National Research Foundation and the National Natural Science Foundation of China (Grant No. 50911130230) to the Danish–Chinese Center for Nanometals, within which this work was performed.

References

1. Xiaodan Zhang, Andrew Godfrey, Xiaoxu Huang, Niels Hansen, Qing Liu. Microstructure and strengthening mechanisms in cold-drawn pearlitic steel wires. ACTA MATERIALIA, 2011, 59, 3422-30.
2. Xiaodan Zhang, Andrew Godfrey, Niels Hansen, Xiaoxu Huang, Wei Liu, Qing Liu. On The evolution of cementite morphology in a pearlite steel wire during wet wire drawing. MATERIALS CHARACTERIZATION, 2010, 61, 65-72.
3. Xiaodan Zhang, Andrew Godfrey, Wei Liu, Qing Liu. Study on dislocation slips in ferrite and cementite deformation in cold-drawn pearlitic steel wire from medium to high strain. MATERIALS SCIENCE AND TECHNOLOGY, 2011, 27, 562-7.